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THE IMPROVEMENT OF THE QUALITY OF TROPICAL VEGETABLE OILS

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The Improvement of the Quality of Tropical Vegetable Oils

By J.A. Cornelius, B.Sc., Ph.D., A.R.I.C.

1. The quality of vegetable oils produced in tropical territories can frequently be improved by better processing techniques, which are often quite simple to apply and may follow from research carried out in the United Kingdom or from experience gained with the same produce in more highly developed producing territories. Such improvements are illustrated in this paper by reference to the production of palm oil, coconut oil and groundnut oil.

Palm Oil

2. Nearly one-third of the world's palm oil, amounting to about 200,000 tons per annum, is produced in Nigeria where, over the past 12 years, there has been a great increase in the proportion of edible grade oil produced, which contains a low free fatty acid content (less than 5 per cent free fatty acid, calculated as oleic acid, on arrival in the United Kingdom). This grade of oil is used in the manufacture of margarine and cooking fats. In 1950, only 0.2 per cent of the total palm oil exported from Nigeria was of edible grade, whereas in 1961 over 80 per cent of the total exported was of this quality (1). This has been due to improved methods of processing, and in particular, the appreciation by the producers of the need to sterilise the fruit prior to extraction of the oil.

3. For use in the edible oil industry, this oil, which contains some 1,000 parts per million of carotenoid pigments, must be bleached. This is usually carried out either by the use of an adsorbent earth or by heat in the absence of air or by a combination of both methods. However, Nigerian oil is generally considered to be inferior to palm oil from more highly developed territories with regard to ease of bleaching and hence suffers a discount on the United Kingdom market, often amounting to 30 shillings per ton. Since this loss amounts to a considerable sum over a year the Tropical Products Institute in London was asked to investigate the cause of the difficulty (2,3).

4. From the preliminary studies carried out it was concluded that palm oil is more difficult to bleach when it becomes oxidised and further work indicated that oxidation of the oil could occur both before and after extraction from the fruit. It was found that the fruit contains lipoxidases which cause deterioration of the bleachability of the oil when delay occurs in sterilisation of the fruit after harvesting (particularly if the fruit is bruised). After extraction of the oil, deterioration can occur through atmospheric oxidation when the oil is heated in the presence of air if it contains traces of dissolved metals such as iron or copper which act as catalysts.

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(1) Raymond, W.D., Industrial Mechanization in the Underdeveloped Territories, J. Instn agric. Engrs, 16, 70-78 (1960).

(2) Ames, G.R. et al., The Bleachability of Nigerian Palm Oil, J.Sci. Fd Agric. 11, 194-202 (1960).

(3) Raymond, W.D., The Palm Oil Industry, Tropical Science, H.M. Stationery Office, 3, 68-89 (1961).

5. Whereas in the Far East, nearly all the palm oil is produced on a large scale from trees grown in plantations, in Nigeria, the bulk of the oil is peasant produced from semi-wild trees, but it has been shown in the Tropical Products Institute that oil extracted from carefully harvested Nigerian fruit can have a bleachability which is at least as good as, if not superior, to that of commercial oil from Malaya or Indonesia (2).

6. Before extraction, enzyme oxidation can be minimised by (a) taking steps to avoid bruising the fruit during harvesting, (b) sterilizing the fruit with the minimum of delay after harvesting, and (c) sterilizing the fruit on the bunch. After extraction, atmospheric oxidation can be minimised by (a) avoidance of metallic contamination. Metal oxides (particularly of iron and copper), and also the metals themselves to a lesser extent, are dissolved by the free fatty acids present in the oil, but if the suggestions for minimising enzyme oxidation are carried out the oil should also have a low free fatty acid content. Contact with copper (a more effective catalyst than iron) and its alloys should be particularly avoided. A probable source of iron contamination in Nigeria is from the drums in which the oil is transported from the producing areas to the coast, particularly since they are frequently rusty inside. The substitution of road tankers or the use of epoxy-resin lined drums has been suggested, but at least the drums should be clean and free from rust. (b) Avoidance of undue heating of the oil in the presence of air. It is only as the factors causing deterioration are appreciated that such practical steps to overcome them will be undertaken.

7. With regard to processing the fruit and extraction of the oil, interest in many of the oilpalm areas has been shown in a small hydraulic hand press which has recently appeared on the market and is claimed to have an extraction efficiency as high as 95 per cent. The West African Institute for Oil Palm Research at Benin, Nigeria have evolved a small-scale procedure using this press together with simple apparatus for sterilizing the fruit as quartered bunches, pounding the fruit, and clarifying the oil; and this has yielded oil of excellent bleachability (4).

Coconut oil

8. Coconut oil, which is widely used in the manufacture of margarine, compound cooking fat, soap and for other industrial purposes, is extracted from copra, the dried kernel of the coconut. The world production of copra amounts to over 3 million tons, equivalent to over 2 million tons of oil (5). The residual cake or meal are valuable protein concentrates for supplementary animal feeds. The quality of the crude oil depends upon the quality of the copra from which it is derived, which in turn largely depends upon proper and adequate drying when it is being prepared. Moisture is a prime factor in the deterioration of copra quality since if present in amounts greater than about 9 per cent it results in progressive deterioration due to attack by bacteria and yeasts followed by successions of moulds and insects; some of the insects feeding on the moulds. Mites are particularly serious pests since they reduce the copra to dust. Infestation not only causes a loss of weight but also deterioration in value since such copra yields an oil of high free fatty acid content and of a dark colour with corresponding increased refining losses and bleaching costs.

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(4) West African Institute for Oil Palm Research, Advisory Sheets, Nos. 8, 9 and 10.

(5) Commonwealth Economic Committee, Vegetable Oils and Oilseeds, a Review, H.M. Stationery Office, London (1962).

9. Only in comparatively few areas of the tropics can complete reliance be placed upon sun-drying alone. Artificial drying is more generally employed, or a combination of sun-drying and artificial drying. The latter may involve either smoke curing or drying over an open fire, or indirect drying, either on a heated platform or in an enclosed chamber heated by flues. Of the two methods of artificial drying, the indirect driers normally give the best quality product and can, with the exception of a few commercially manufactured continuous driers, be constructed almost entirely locally (6). The Tropical Products Institute has in the past, in response to numerous requests, provided information on such driers to copra producing territories.

10. The ability to grade copra according to its quality, which particularly involves the assessment of moisture content, is highly desirable both for the producer and the trader. For the determination of moisture there are various simple 'field' tests such as inspection for 'water line', the sound made on breaking and the burning test. These rough tests are all empirical. However, moisture content can be determined in the field more accurately by means of a moisture meter such as one relying upon electrical measurement of dielectric constant or resistance. A probe meter based on resistance measurements has been developed by the Pest Infestation Laboratory (7) and calibrated to give direct readings of moisture content. This instrument has been circulated for trial in several coconut growing areas and its applicability for the purpose has shown promise.

There are many advantages to be gained in extracting the oil from the fresh coconut since this avoids the pitfalls inherent in copra production and also the oil so produced is normally of much lower acidity and of better quality than that obtained from copra. Also, both milk and meal are produced as useful by-products. Many methods have been patented for extracting fresh coconuts (8,9) but only two have ever been used commercially as far as is known, and these only in the Philippines. In one of these processes the sliced copra meat is dried before pressing; but in the other process, which is understood to have superseded the first, the sliced coconut meat is pressed before drying, the expressed milk centrifuges to separate the 'cream' which is then cooled to form solid pellets; these are centrifuged again after melting. If an economic process suitable for the underdeveloped territories were to be developed for the extraction of oil from fresh coconuts - one which provided an outlet also for the by-products obtained - it would be of great value to them.

Groundnut oil

12. In Nigeria, up to about seven years ago, groundnuts for crushing were decorticated by the producer almost entirely by pounding the pods in a household mortar. This resulted in only about one-third of the kernels remaining whole.(1) It has been shown that kernel breakage is one of the main factors contributing to increase in acidity on storage (10). The widespread introduction of comparatively simple and

(6) Aten, A. et al., Copra Processing in Rural Industries, F.A.O., Rome (1958).

(7) Tropical Stored Products Information, No.1, 15-16, Pest Infestation Laboratory, Slough, Bucks (1959).

(8) United States Patent, No. 2,742,487.

(9) Nathanael, W.R.N., Chemical and Technological Investigations on Coconut Products, Ceylon Coconut Quarterly, 11, 42 (1960).

(10) Raymond, W.D., The Decortication of Groundnuts, Colon. Pl. Anim. Prod. H.M. Stationery Office, 2, 265 (1951).

cheap hand decortication machines for use by the farmer (Figure I) for which the Tropical Products Institute has been largely responsible, has considerably reduced the breakage during decortication, and today, practically the whole decorticated crop contains at least 70 per cent of whole nuts. The steady decrease in the acidity of the exported nuts since these decorticators were first introduced in the 1954-1955 season is demonstrated by the following figures:

Table 1

Season	Average free fatty acid content of oil, per cent	Total crop, thousand tons of decorticated nuts
1954/55	5.07	375
1955/56	3.34	530
1956/57	2.05	357
1957/58	2.94	714
1958/59	1.76	533
1959/60	1.26	445
1960/61	1.46	619

This improvement in the quality of the exported nuts means an increase in the value of the extracted oil owing to the decreased refining losses involved. For the whole crop this has been estimated to amount to a saving of over £1,000,000 for the 1960/61 season alone.

Figure I Hand Decorticator for Groundnuts

Thus, in the case of palm, coconut and groundnut oils, the application of the findings of simple commodity research has resulted in benefits of considerable financial value due to improvements in quality and in some cases with an increased weight of marketable products.

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